



ENVIRONMENTAL STRATEGIES CORPORATION

Four Penn Center West • Suite 315 • Pittsburgh, Pennsylvania 15276 • (412) 787-5100 • Fax (412) 787-8065

**PRELIMINARY CONCEPTUAL SITE MODEL
AND PROPOSED GROUNDWATER INVESTIGATION PLAN
CROMPTON CORPORATION
PETROLIA, PENNSYLVANIA**

PREPARED

BY

ENVIRONMENTAL STRATEGIES CORPORATION

JUNE 13, 2001

docs/Crompton/138093/Pre Conceptual Site Model.doc

Contents

	Page
1.0 Introduction	1
1.1 Site Description	1
1.2 Historical Petroleum and Natural Gas Production Activities	4
1.3 Historical Mining Activities	4
2.0 Environmental Setting	6
2.1 Site Physical Characteristics	6
2.2 Site Geology	6
2.3 Site Hydrogeology	8
2.4 Surface Water	10
2.5 Wetlands	11
2.6 Rare, Threatened, and Endangered Species	11
3.0 Environmental Media Evaluation	12
3.1 Soil	12
3.1.1 General Data Observations	13
3.1.2 Soil Characterization Findings	16
3.2 Groundwater	20
3.3 Surface Water	21
4.0 Potential Receptors and Pathways of Exposure	24
4.1 Soil	26
4.2 Groundwater	26
4.3 Surface Water	26
4.4 Ecology	27
5.0 Conceptual Site Model Summary	28
6.0 Proposed Groundwater Investigation Plan	30
6.1 Management Area Geology	30
6.2 Proposed Investigation Strategy	33
7.0 References	35

Contents
(continued)

List of Tables:

Table 1 -	Background Soil Sampling Results
Table 2 -	Area of Concern 8 - Surface Soil Sampling Results Summary
Table 3 -	Area of Concern 8 - Subsurface Soil Sampling Results Summary
Table 4 -	Area of Concern 9 - Surface Soil Sampling Results Summary
Table 5 -	Area of Concern 9 - Subsurface Soil Sampling Results Summary
Table 6 -	Area of Concern 10 - Surface Soil Sampling Results Summary
Table 7 -	Area of Concern 10 - Subsurface Soil Sampling Results Summary
Table 8 -	Area of Concern 11 - Surface Soil Sampling Results Summary
Table 9 -	Area of Concern 11 - Subsurface Soil Sampling Results Summary
Table 10 -	Area of Concern 12 - Surface Soil Sampling Results Summary
Table 11 -	Area of Concern 12 - Subsurface Soil Sampling Results Summary
Table 12 -	Area of Concern 13 - Surface Soil Sampling Results Summary
Table 13 -	Area of Concern 13 - Subsurface Soil Sampling Results Summary
Table 14 -	Area of Concern 14 - Surface Soil Sampling Results Summary
Table 15 -	Area of Concern 14 - Subsurface Soil Sampling Results Summary
Table 16 -	Area of Concern 15/Area 5 - Surface Soil Sampling Results Summary
Table 17 -	Area of Concern 15/Area 5 - Subsurface Soil Sampling Results Summary
Table 18 -	Area of Concern 16 - Surface Soil Sampling Results Summary
Table 19 -	Area of Concern 16 - Subsurface Soil Sampling Results Summary
Table 20 -	Area of Concern 17 - Subsurface Soil Sampling Results Summary
Table 21 -	Area of Concern 17A - Surface Soil Sampling Results Summary
Table 22 -	Area of Concern 17A - Subsurface Soil Sampling Results Summary
Table 23 -	Area of Concern 18 - Surface Soil Sampling Results Summary
Table 24 -	Area of Concern 18 - Subsurface Soil Sampling Results Summary
Table 25 -	Area 15 - Surface Soil Sampling Results Summary
Table 26 -	Area 15 - Subsurface Soil Sampling Results Summary
Table 27 -	Summary of SPLP Analytical Results
Table 28 -	Results of Statistical Analysis
Table 29 -	Soil Constituents With Detection Limits Above Screening Criteria
Table 30 -	Summary of Groundwater Analytical Results
Table 31 -	Summary of Groundwater Analytical Results - Preliminary Remedial Investigation
Table 32 -	Summary of Surface Water Analytical Results
Table 33 -	Groundwater Monitoring System Rationale

Contents
(continued)

List of Figures:

- Figure 1 - Facility Location
- Figure 2 - Site Layout Map
- Figure 3 - Oil and Gas Well Locations
- Figure 4 - Coal Seam Outcrop Map
- Figure 5 - Generalized Stratigraphic Column
- Figure 6 - Cross Section Location Map
- Figure 7 - Cross Section A-A'
- Figure 8 - Cross Section B-B'
- Figure 9 - Cross Section C-C'
- Figure 10 - Wetlands Inventory Map
- Figure 11 - AOC 8, 15, and Area 5, Test Pit or Soil Boring Locations Map
- Figure 12 - AOC 9, 11, and 12, Test Pit or Soil Boring Locations Map
- Figure 13 - AOC 10, 13, 14, 18, and 18A, Test Pit or Soil Boring Locations Map
- Figure 14 - Area 15 and AOC 16, Test Pit or Soil Boring Locations Map
- Figure 15 - AOC 17 and 17A, Test Pit or Soil Boring Locations Map
- Figure 16 - Surface Water and Groundwater Sampling Locations for November 29, 2000
- Figure 17 - Well Location Map
- Figure 18 - Conceptual Site Model
- Figure 19 - Management Areas and Proposed Groundwater Investigation Plan
- Figure 20 - Cross Section Location Map - Management Areas
- Figure 21 - Management Area 1 Cross Sections
- Figure 22 - Management Area 2 Cross Sections
- Figure 23 - Management Areas 3 and 5 Cross Sections
- Figure 24 - Management Areas 4 and 6 Cross Sections
- Figure 25 - Management Area 7 Cross Sections

List of Appendices:

- Appendix A - Example SVOC Chromatogram
- Appendix B - Example Mass Spectral Scan of Tentatively Identified Compounds
- Appendix C - Mass Balance Model Calculations

1.0 Introduction

This preliminary Conceptual Site Model (CSM) was prepared for the Crompton Corporation (Crompton) facility in Petrolia, Pennsylvania in response to a request by representatives of the Pennsylvania Department of Environmental Protection (PADEP) and U.S. Environmental Protection Agency (EPA) in a meeting on January 4, 2001. The purpose of the CSM is to summarize Crompton's current understanding of the site based on data collected to date and to define the site management strategy moving forward. It is preliminary in nature because the remedial investigation (RI) activities to be conducted by Crompton at the facility have not been completed. Nevertheless, enough data have been collected to evaluate preliminarily the potential exposure pathways and receptors that may be of interest. In addition, the CSM was used as the basis for developing the groundwater investigation plan in a manner that meets all applicable federal and state regulatory requirements.

The Proposed Groundwater Investigation Plan included in Section 6 of this document sets forth Crompton's approach for gathering additional groundwater data to complete the site investigation process. With this additional information, Crompton will be in a position to define future site remediation approaches.

Crompton's efforts with respect to this site investigation are intended to satisfy the Corrective Action requirements under the Resource Conservation and Recovery Act ("RCRA") and the requirements of the Land Recycling and Environmental Remediation Standards Act ("Act 2") for site remediation activities. EPA and PADEP have agreed to work together to enable Crompton to satisfy these federal and state requirements for the remediation of the facility. This CSM has been prepared to facilitate a coordinated approach to accomplish that result in an efficient and timely manner.

1.1 Site Description

Crompton owns and operates a specialty oil manufacturing facility located on approximately 175 acres along Route 268 in Petrolia, Butler County, Pennsylvania (Figure 1). The facility has been in operation since 1885. Approximately one-third of the property is occupied by the operational area of the facility and the balance of the

facility is undeveloped. As shown on Figure 1, the majority of the facility operations are situated within the northeast corner of the property.

The facility is located within an area that is primarily rural in nature, characterized by small towns and residential areas that are widely spaced. Two other industrial properties are located within the vicinity of the facility. Indspec is immediately adjacent to the northeast corner of the facility, and Penreco is located to the south of the facility, across a small strip of undeveloped land. Both companies operate white oil manufacturing facilities, similar to Crompton's facility. Undeveloped land and land used for strip mining surrounds the majority of the facility to the south, southwest, and west. A small strip of residences is located along the northern facility boundary. The area immediately east of the site has few houses and is primarily undeveloped. The Borough of Petrolia is located to the northeast of the facility (Figure 1).

The facility's primary products include white oils, petrolatums, and microcrystalline waxes. The primary standard industrial code for the facility is 2999. Current manufacturing processes conducted on site include hydrogenation of oils, waxes, and petrolatums; barium sulfonate conversion; material blending; warehousing; and distribution. Major operations areas of the facility are shown on Figure 2.

The primary raw materials used by Crompton include natural oil manufactured from an offsite crude oil refining process, natural gas, barium compounds, petrolatum feedstock, wax feedstock, sodium sulfonate, and methanol. The majority of raw materials used at the facility are stored in aboveground tanks.

The facility currently is regulated as a large quantity generator of hazardous waste and operates under EPA identification number PAD004388500. Hazardous wastes generated at the facility include barinate filter cake and laboratory waste. The facility also maintains a RCRA permit-by-rule (PBR) for its wastewater treatment system.

Historically, 18 solid waste management units were identified at the Crompton facility. Eight of these units were formally closed under the direction and with the approval of PADEP (identified as areas of concern, or AOCs, 1, 2, 3, 4, 5, 6, 7 and 8). Six of these units were closed under Consent Orders, one unit (AOC 3) was closed in accordance with a PADEP-approved closure plan, and one unit (AOC 8) was closed with PADEP oversight. Because these units were closed in compliance with PADEP

requirements, EPA and PADEP have agreed that no further characterization or evaluation of these eight areas is necessary. This approach formed the basis for the Remedial Investigation (RI) Work Plan (ESC, 2000) that was reviewed and commented upon by both EPA and PADEP.

The RI work plan identified 11 AOCs and two former operational areas that required additional assessment in order to obtain a release of liability under Act 2 and to satisfy federal Corrective Action requirements. The AOCs and operational areas identified are the following:

- AOC 8 – former Lagoon No. 3 - closed by waste stabilization and removal in 1984/85 under PADEP oversight
- AOC 9 – former land fill area - closed by the facility by removing free liquids and backfilling with soil and ash
- AOC 10 – spray irrigation field - practice discontinued in 1970; the hillside was allowed to revegetate naturally
- AOC 11 – Impoundment No. 5 - closed by the facility in 1974 by backfilling with soil
- AOC 12 – former lagoon area - closed by the facility in 1969 by removal of liquids and backfilling with soil and ash
- AOC 13 – former landfill area - closed by the facility in the early 1970s by backfilling with material excavated from the construction of the Hydrogenation Plant
- AOC 14 – former landfill area - closed by the facility at the same time and in the same manner as AOC 13
- AOC 15 – acidified oil sludge lagoon - closed by the facility in 1934 when the acid plant was constructed above the lagoon
- AOC 16 – waste area - located under the present sulfonate plant (constructed in 1941)
- ✓ • AOC 17 (and AOC 17A) – Wemco float disposal area - closed as a residual waste landfill in 2000 with approval from PADEP
- AOC 18 (and AOC 18A) – Lagoon Nos. 1 and 2 sludge disposal area - no longer in operation

- Area 5 – former Acid Plant location
- Area 15 – former Acidified Oil storage

It should be noted that (1) AOC 8 and the former operational areas are not subject to RCRA Corrective Action requirements because they are not considered Solid Waste Management Units; and (2) AOC 17 was closed under the current Pennsylvania residual waste regulations and is subject to ongoing groundwater monitoring requirements that will be incorporated into the overall groundwater investigation strategy for the facility. ✓ are they asking

1.2 Historical Petroleum and Natural Gas Production Activities

Environmental Strategies Corporation (ESC) visited the Pennsylvania Department of Conservation and Natural Resources (PADCNR), PA-Geologic Survey on March 13, 2001, and reviewed both the Parker and Chicora Quadrangles for Butler County to determine the number of oil and gas wells on the facility property and in the immediate vicinity. Eight wells are located in the immediate vicinity of the site (Figure 3). According to the most recent oil and gas well survey, only two wells are located on the facility property (019-01967 and 019-01968). According to the well registration form, both wells are oil wells, registered to Dennis N. Brown/Arthur D. Leighton. ESC contacted the well owners and ascertained that the wells currently are operational. Crompton does not participate in the maintenance or operation of the wells and has not conducted oil or natural gas production operations at the facility.

1.3 Historical Mining Activities

Research into historical mining activities at the Crompton facility was conducted by ESC including a meeting with Bill Winters of the PADEP District Mining Operations office; a telephone conversation with Terry Elikier, safety inspector, Knox Pennsylvania Mining Operations; and a telephone conversation with Dan Threlfall of Chemviron (who previously researched mining activities at the facility). Based on information provided by PADEP, three active mines were noted in the area, Rosebud Mine No. 1, Rosebud Mine No. 2, and Bear Run. The Rosebud Mine western boundary is approximately 20,000 feet east of the facility. The lower Kittanning Coal is mined here. There is active mining at both the No. 1 and No. 2 mines. The permit was recently renewed in 1999 and

is valid for approximately five years. No detailed information was available from PADEP regarding the Bear Run mine. Mr. Winter stated that he believes that the south branch of Bear Creek provides enough of a hydrogeologic divide to prohibit the flow of acid mine drainage near the Crompton facility groundwater regime. Also, based on a rough geologic cross section from the facility to the Rosebud mining area, the stratigraphy is incised by the local stream valley.

ESC contacted Mr. Threlfall regarding void spaces that were found during subsurface sampling activities at the facility. Mr. Threlfall indicated that during Chemviron's investigation at the site, voids also were encountered in the "New Landfill" area at an approximate elevation of 1,400 feet above mean sea level (MSL). He stated that a coal seam exists between 1,250 and 1,300 feet MSL with a south-southwest dip. ✓ Some 3 to 4-foot voids due to roof collapse are present in addition to some smaller voids. Deep mining did occur in the area around the turn of the century, but no maps exist of the exact mining locations. This mining was in the "root zone" with very little overhead.

Chemviron obtained information from WPA mine maps that showed no deep mining occurred beneath the Crompton facility. Small workings were shown 0.5 miles to the north and southwest. Additionally, a map of mines in the Parker Quadrangle did not show any mines beneath the site. Mr. Threlfall reviewed files and maps at PADEP (then the Pennsylvania Department of Environmental Resources). No record of mining was found and it was noted by PADEP that voids could be the result of small "county pits" which are small localized mining operations.

Terry Elikor was contacted by ESC regarding surface mining in the area of the Crompton facility. Ms. Elikor stated that no bonded mining activities were located around the facility within a one-mile radius. She indicated that there has been some mining in the area in the past, but these mines are no longer bonded.

To determine the potential locations of "county pits", ESC reviewed the Coal Resources of Butler County (1985). In the report, the Lower and Middle Kittanning Coal and the Lower and Upper Freeport Coal are shown to outcrop across the facility. ESC assumed that coal outcrops would be the most likely locations for "county pits". Figure 4 illustrates the approximate locations of the coal crop lines (coal outcrop elevations), as well as the voids encountered during subsurface investigations of the facility.

2.0 Environmental Setting

This section describes the facility's physical characteristics, geology, and hydrogeology based on previous investigations and data collected during this investigation.

2.1 Site Physical Characteristics

The facility is located in Fairview Township and is adjacent to the Borough of Petrolia to the northeast, Karns City is located to the south (Figure 1). Elevation of the ground surface ranges from approximately 1,170 to 1,450 feet MSL. The facility is located in the Allegheny Plateau physiographic province which is characterized by rounded hills and steep-sided valleys. Flat upland surfaces are rare, and where present, are small. Flood plains are present along some of the streams. The South Branch of Bear Creek flows from the south to the north along the eastern portion of the facility. The main portion of the facility lies on the western side of the creek.

The majority of the production facilities are located on the lower portion of the valley, with the exception of the Hydrogenation Plant located along the western slope of the valley. Aboveground tanks are mainly located on the upper slopes.

The regional surface water drainage patterns are primarily dendritic. Surface water runoff from facility processing and tank farm areas are captured by either storm sewers and oil/water separator systems or process sewers and sumps which direct process and storm water to the wastewater treatment plant. Treated wastewater is discharged to the creek in accordance with National Pollutant Discharge Elimination System (NPDES) Permit number PA 0002666.

2.2 Site Geology

The facility is covered with unconsolidated material that is underlain by sedimentary rocks of Pennsylvanian age. Figure 5 provides a generalized stratigraphic column of the area. The geologic strata in the regional vicinity dip gently southward toward the Pittsburgh-Huntington Basin. A series of southwest to northeast trending folds, basins, and domes are superimposed on this regional structure. The facility is

located on the southern flank of the Petrolia Dome. These rocks have been eroded within stream valleys and covered with unconsolidated sediments, presumably Quaternary alluvium and fill material.

The facility is underlain by the Conemaugh and Allegheny Groups. The Conemaugh Group includes the Glenshaw Formation beneath the facility. This formation is comprised predominantly of shale, silty shale, claystone, fine to coarse-grained sandstone, and limestone, and locally present thin beds of coal.

The Allegheny Group, which underlies the Conemaugh Group, includes the Freeport and Kittanning Formations. The Freeport is comprised of claystone, shale, and siltstone, and two commercial grade coal seams (the Upper and Lower Freeport Coal) which have been strip and deep mined along the western perimeter of the facility property as reported by Dodge (1985) and observed during implementation of the closure plan for the inactive landfill (NUS, 1985). The Kittanning Formation is comprised predominantly of sandstone (Worthington), shale, siltstone, limestone (Vanport), two commercial grade coal seams (the Upper and Middle Kittanning Coal), and some claystone.

Based on boring log data prepared by others during previous investigations and by ESC during preliminary RI activities, the depth to bedrock across the facility ranges from 10 feet (OW-1) to 54 feet (EB-2) below ground surface (bgs). The bedrock is overlain by alluvium (silt and sand) and fill material (soil and rock fragments, coke fines, and a variety of demolition debris). The bedrock surface generally mimics the surface topography sloping toward the eroded bedrock stream valleys. Several local exceptions exist within areas where coke fines or demolition debris have been deposited or where cut and fill activities have occurred during facility construction and operation.

Three generalized geologic cross sections were developed to depict the facility geology. The cross section locations are shown on Figure 6. Cross section A-A' traverses the facility in a west to east direction (Figure 7). The cross section shows a varying thickness of fill and unconsolidated deposits (sand, silt, and clay) overlying the shale, sandstone, and claystone bedrock that slopes east toward the South Branch of Bear Creek. The cross section shows a rapid horizontal and vertical change in bedrock lithology characteristic of the Conemaugh and Allegheny Groups. The dominant

subsurface feature is the presence of an area where coke fines were historically placed. This area measures approximately 960 feet long by as much as 55 feet in depth.

Cross section B-B' (Figure 8) traverses the facility in the south to north direction at a location east of the closed landfill (AOC 4) and temporary landfill (AOC 5) areas. The cross section shows varying thickness of fill, coke fines, and unconsolidated deposits overlying a shale, claystone, sandstone, siltstone bedrock surface. Dominant subsurface features include the presence of a 4-foot to 6-foot void which exists at an elevation of approximately 1,340 feet MSL where the Upper Freeport Coal seam has been deep mined from beneath the western perimeter of the facility. In addition, an eroded bedrock surface overlain by weathered bedrock, unconsolidated deposits, fill material, and coke fines is depicted on this cross section. The northern limits of the coke material described in cross section A-A' can also be seen in borings OW-3 and EB-1.

Cross section C-C' (Figure 9) traverses the facility in the south to north direction along the eroded bedrock stream valley. The cross section shows varying thickness of fill material and unconsolidated deposits overlying sandstone and shale formations. The ground and bedrock surface elevations decrease with proximity to the South Branch of Bear Creek.

2.3 Site Hydrogeology

The groundwater regime beneath the facility is generally characterized by water-bearing zones present within unconsolidated material (soil, fill, and/or waste material), within shallow bedrock, and within deep bedrock formations. Groundwater flow in these zones is controlled by the local topography, vertical infiltration, geologic structure, or mining activities. Groundwater elevations within the shallow and deep bedrock aquifer systems are shown in the general site cross sections (Figures 7, 8, and 9). The groundwater elevations were measured following borehole or monitoring well completion and, therefore, may not represent similar groundwater conditions.

Groundwater present within unconsolidated material exists in localized perched aquifer zones under unconfined conditions throughout the facility. These aquifers are formed by rainfall percolating through unconsolidated material and collecting on lower permeable deposits. Groundwater from this zone discharges to local creeks on the

property or to the ground surface via seeps. The groundwater flow direction in this zone is controlled by local topography and the permeability of aquifer materials.

Based on previous groundwater investigations at the facility, three relatively shallow bedrock aquifers (i.e., Butler Sandstone, Freeport Sandstone, and Worthington Sandstone) have been identified to represent the first continuous water-bearing zone depending on the elevation of each area of concern. Because of the topographic relief at the site, these aquifers may exist beneath certain AOCs, but not others. The groundwater investigation strategy being developed for this facility will take this into account. ✓

In general, groundwater flow in the bedrock aquifers occurs along the bedrock interface and within bedding planes, fractures, or joints. This water-bearing zone is recharged by surface water infiltration and/or leakage from local streams. The groundwater flow direction in this zone is controlled by local topography and structure. Groundwater present within the bedrock zones is of primary interest because it is the first continuous aquifer present beneath the facility. Groundwater quality in this zone is known to be affected by acid mine drainage resulting from coal strip and deep mining activities in the area, including former offsite upgradient activities. Underlying formations prevent significant vertical groundwater migration because, as discussed below, vertical fracturing is absent in the upper portion of the intermediate bedrock that underlies the shallow bedrock beneath the facility. ?

The Butler Sandstone aquifer exists at approximately 1,310 feet MSL. It occurs under most of the site, although it is eroded away in the bedrock valley. The upper unit of this aquifer consists of gray limestones underlain by shale and siltstone and the Lower Freeport Coal. Based on the available data, the direction of groundwater flow is expected to be to the south. Observed water levels in existing monitoring wells OW-1, OW-2, and OW-3, range from approximately 1,327 to 1,337 feet MSL. This aquifer is under both water table and semi-confined conditions. The direction of groundwater flow reflects the structure contour of the Lower Freeport Coal and local surface morphology.

The Freeport Sandstone aquifer exists at approximately 1,270 feet MSL. This aquifer appears to be under unconfined or semi-confined conditions. The direction of groundwater flow is likely controlled by local topography and geologic structure. As such, the direction of groundwater flow is expected to be to the south. One piezometer

(EB-1), which no longer exists, was installed in the Freeport Sandstone. The water level in this piezometer was reported at approximately 1,300 feet MSL. Claystone, siltstone, and shale occur below the Freeport Sandstone. The thickness of these strata is approximately 20 feet. Permeability tests of these strata indicated that the hydraulic conductivities range from 10^{-5} to 10^{-6} centimeters per second (cm/s), which is representative of a confining layer. Thus, the Freeport Sandstone appears to be partially isolated from the underlying units.

The Worthington Sandstone aquifer exists at approximately 1,210 feet MSL. Seven monitoring wells (MW-6 through MW-10, W-1, and W-2) at the site are completed in this aquifer. Based on the data and water level observations, this unit appears to be unconfined. The results of slug tests in W-1 and W-2 reveal hydraulic conductivities ranging from 10^{-5} to 10^{-6} cm/s.

Groundwater within deep bedrock formations exists within intermediate and deep aquifer systems under confined conditions. Based on the results of a previous intermediate and deep aquifer study (Chemviron, 1987), the intermediate aquifer exists at a depth of 150 to 230 feet bgs and the deep aquifer ranges from 350 to 500 feet bgs. This study reported that vertical fractures do not provide a means of significant hydraulic communication between the two aquifers. The study also concluded that groundwater quality in these two aquifers was not affected by surface activities or water quality in the shallow bedrock aquifer. — OK

2.4 Surface Water

The South Branch of Bear Creek is classified for the following designated uses: warm water fish, aquatic life, water supply, and recreation. The main stem and unnamed tributaries of Bear Creek are classified for cold water fish, aquatic life, water supply, and recreation. An unnamed tributary to the South Branch of Bear Creek [Segment 6970 in the State Water Plan 17C, 305(d) List of Streams and Rivers 2000] is listed as impaired from stream mile 0.85 to the confluence with the South Branch of Bear Creek due to acid mine drainage contributing metals. This tributary enters the South Branch of Bear Creek at stream mile 5.1 near Karns City, upstream of the facility location at stream mile 3.52. In 1998, in addition to segment 6970 listed as above, the main stem of the South Branch ✓

of Bear Creek (stream code 5356 at stream mile 5.62) was listed due to acid mine drainage (metals) and industrial point source (priority organics) from stream mile 5.48 to the confluence with Bear Creek. ✓

2.5 Wetlands

The U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory map (USFWS, 1973) indicated several wetlands on and adjacent to the site (Figure 10). The onsite pond wetland is classified as palustrine, open water/unknown bottom, and intermittently exposed/permanent (POWZ). The South Branch of Bear Creek is classified as a riverine, upper perennial, open water/unknown bottom, and intermittently exposed/permanent (R3OWZ) wetland within the channel. Upstream of the site, palustrine, forested, broad-leaved deciduous, temporarily flooded (PFO1A) wetlands occur along South Branch of Bear Creek. There were no wetlands identified in any AOC.

2.6 Rare, Threatened, and Endangered Species

Letters requesting information on rare, threatened, or endangered species on and adjacent to the facility have been submitted to Pennsylvania Department of Conservation and Natural Resources and the U.S. Fish and Wildlife Service.

3.0 Environmental Media Evaluation

Characterization of the AOCs and former operational areas has been conducted in accordance with the RI Work Plan. Field activities including soil, groundwater, and surface water sampling have been conducted in phases beginning in May 2000 through March 2001. The data collected as of the date of this CSM are presented and discussed in this section.

3.1 Soil

Soil characterization activities were completed in accordance with the RI Work Plan from May 2000 to March 2001. Soil samples were collected from soil borings and test pits in AOCs 8 through 18A and operational Areas 5 and 15. The samples were analyzed for volatile organic compounds (VOCs) using EPA SW-846 Method 8260, semivolatile organic compounds (SVOCs) using EPA SW-846 Method 8270, and the Act 2 metals using EPA SW-846 6000/7000 series methods. Select soil and waste samples also were analyzed using the Synthetic Precipitation Leaching Procedure (SPLP), Method 1312, solely to evaluate the potential for constituents present within the soil and waste to migrate to groundwater. (Crompton understands that Act 2 remediation standards do not apply to wastes.)

A summary of the soil analytical data for each AOC and former operational area is presented on Tables 1 through 27. The tables are separated into surface (0 to 2 feet bgs) and subsurface (greater than 2 feet bgs) sample results and present only those constituents with concentrations above the laboratory reported detection limits. The soil sample locations are shown on Figures 11 through 15.

To facilitate the evaluation of metals identified in soil samples collected from the facility, 12 background soil samples were collected from areas of the facility where no operations are known to have occurred. The background samples were analyzed for arsenic, lead, and thallium using the same EPA methods as the soil samples described previously. A summary of the analytical data for the background samples is presented in Table 1.

OK?

The soil data were compared to screening criteria to evaluate the need for either additional soil characterization or to guide the development of the groundwater investigation strategy for the facility. The screening criteria included:

- Act 2 Statewide Health Standards – medium-specific concentrations (MSCs) for evaluation of the soil to groundwater pathway, non-residential exposures
- EPA Region 3 Risk-Based Concentrations (RBCs) – for direct contact with soil, industrial exposures

3.1.1 General Data Observations

Some concentrations of arsenic were observed to be above the RBC value of 3.8 milligrams per kilogram (mg/kg) for industrial exposures; however, none of the arsenic concentrations from any of the AOCs were above the Pennsylvania Act 2 MSC of 150 mg/kg for evaluation of the soil to groundwater pathway.

As described previously, to evaluate the arsenic in soil at the facility, ESC collected background soil samples in November 2000. A summary of the background soil sample data are provided in Table 1. The background arsenic concentrations were compared to the arsenic concentrations from each AOC, for both surface and subsurface soil, using a statistical analysis for unpaired data. To perform the analysis, a statistical software program was used; the program is available from the following web address: www.statibot.com/english/. The procedure used is described below and was used in accordance with Section 4.0 Part B - Attainment Demonstration with Statistical Methods from the Act 2 Technical Guidance Manual (PADEP, 1997).

- The data were sorted according to categories, either as being from background or from an AOC.
- The distribution of each data set was evaluated using a D'Agostini test. The results of this evaluation are presented in Table 28.
- The means of the arsenic data from each AOC were compared to the mean of the background data using either a Mann-Whitney U test (also known as the Wilcoxon Rank Sum test) for a non-normal distribution or a Double t test for a normal distribution. The results of this comparison and the associated P values are presented in Table 28.

For AOC 11 (surface soil only), AOC 13, and AOC 14, an insufficient number of samples were collected to allow for statistical evaluation of the arsenic data. In these areas, no arsenic concentrations were found to exceed the Act 2 MSCs for non-residential direct contact (surface – 53 mg/kg; subsurface – 190,000 mg/kg) or for the soil to groundwater pathway (150 mg/kg).

As shown in Table 28, the arsenic concentrations in the subsurface soil samples from AOC 9, AOC 11, and Area 15 were not similar to the background concentrations. For all other AOCs that were evaluated, the arsenic concentrations were similar to background in both surface and subsurface soil. Within AOC 9, AOC 11, and Area 15, the arsenic concentrations in the subsurface soil do not exceed the Act 2 MSCs for non-residential direct contact with subsurface soil (190,000 mg/kg) or for the soil to groundwater pathway (150 mg/kg).

A review of the arsenic concentrations for background and each AOC shows that either the concentrations within the AOCs are similar to background, or the concentrations do not exceed the relevant Act 2 MSCs. As a result, no further delineation of the arsenic concentrations in soil at the facility is believed to be warranted.

A review of the analytical data for each AOC shows a high level of consistency with respect to the specific constituents where the laboratory-reported practical quantitation limit (PQL) exceeds the screening criteria. A list of these constituents is provided in Table 29. During the preparation and review of the RI Work Plan and Data Quality Objectives documents, the following six constituents were identified as having the potential for the PQLs to exceed the relevant screening criteria:

Volatile Organics:

- vinyl chloride
- Chloromethane
- 1,2-dibromo-3-chloropropane

Semivolatile Organics:

- N-nitrosodi-n-propylamine
- benzo(a)pyrene
- dibenz(a,h)anthracene

In a letter, dated May 16, 2000, ESC stated in response to comments from the EPA on the proposed Data Quality Objectives, that the laboratory would be requested to report the results for these six constituents to the PQLs. Further, the laboratory would be requested

to qualify any detected compound with a concentration greater than the method detection limit (MDL) and less than the PQL as "J", indicating that the reported concentration is an estimated value. These constituents were not considered to be of interest based on the history of the facility and, in fact, few, if any, results were reported above the MDLs, i.e., few J values were reported by the laboratory.

The remaining constituents with PQLs consistently reported above the screening criteria include 1,2-dibromoethane, bis(2-chloroethyl)ether, hexachlorobenzene, arsenic, and thallium (note, arsenic was discussed previously). For these other constituents, the laboratory will be requested to provide MDLs for each constituent based on the relevant instrument calibration data. Concentrations of these constituents that are detected above the MDLs, but below the PQLs originally reported by the laboratory, will be reported and qualified as "J" values. Given the history of the facility, these constituents are not expected to be of interest.

It should be noted that for a limited number of samples in several of the AOCs, elevated detection limits were reported for some SVOCs in addition to those already discussed in this section. For these samples, the laboratory dilution factors ranged from five to 1,000-fold, which raised the reporting limits for undetected compounds accordingly. This is evidence of the sample matrix interfering with the analysis. ESC contacted the laboratory to discuss this issue, and laboratory representatives indicated that the sample extracts were black. Generally, sample extracts are clear for soil that contains low amounts of organic matter and amber if there is a high amount of organic matter. Black extracts usually indicate the presence of interfering organic materials that are extracted from the soil during sample preparation. In many cases the interfering materials were found to be petroleum hydrocarbons. Fourteen of the samples exhibiting high detection limits also exhibited high concentrations of petroleum hydrocarbons reported as diesel range organics (DRO). ✓

Examination of the SVOC chromatograms for several of these samples show the presence of a large petroleum hydrocarbon envelope in the retention time range of 13 to 21 minutes, which is indicative of diesel range organics. An example of this is presented in Appendix A. A library search mass spectral scan of the top ten tentatively identified compound (TICs) on the most significant peaks in the chromatogram also confirmed the

presence of aliphatic hydrocarbons indicative of petroleum compounds in the diesel range, including heptadecane, octadecane, nonadecane, and eicosane. For illustrative purposes, mass spectra of the top ten TICs for one sample are provided as Appendix B. The TICs would have shown the presence of target SVOCs if in fact they were present in these samples.

ESC has approached the laboratory about the use of sample cleanup techniques to resolve the matrix interference issue. The classic method of gel permeation chromatography (GPC) that is recommended in the EPA Contract Laboratory Program Statement of Work (CLP SOW) would not be appropriate in this case. GPC separates petroleum hydrocarbon molecules from target SVOCs based on molecular size. The molecular size of the DRO compounds is very similar to the target SVOCs; therefore, the DRO compounds would be virtually indistinguishable from the target SVOCs. Other techniques including Florisil[®] column cleanup could be appropriate because Florisil[®] has been used to fractionate aliphatic hydrocarbons from polycyclic aromatic hydrocarbons in crude oil. This would involve a significant amount of costly and time consuming laboratory research and may not be successful in removing the matrix interference.

A review of the analytical data for samples in each AOC where the detection limits are not elevated, shows that very few constituents of interest were identified in the soil. Given the industrial nature of the facility, the probability that a risk-based closure alternative will be selected for this site, and that groundwater quality will be evaluated for each MA, additional soil sampling does not appear to be warranted in these areas to address elevated detection limit issues.

Done w/ soil?

3.1.2 Soil Characterization Findings

The results of the RI soil sampling activities are discussed in this section. The data are summarized in Tables 2 through 27, and the soil sample locations are shown on Figures 11 through 15. No constituents of interest were detected in the soil samples collected from AOC 8 (Tables 2 and 3), AOC 10 (Tables 6 and 7), AOC 12 (Tables 10 and 11), AOC 17 (Table 20), AOC 17A (Tables 21 and 22), and AOCs 18 and 18A (Tables 23 and 24). The constituents of interest detected in the remaining AOCs or operational areas are discussed below.

AOC 9

- No constituents of interest were identified in the surface soil samples from this area (Table 4).
- Benzene was detected at a concentration of 620 micrograms per kilogram ($\mu\text{g}/\text{kg}$) in sample 9-SB-3 at a depth of 4 to 6 feet bgs (Table 5), which is above the Act 2 MSC. A soil sample collected from the same depth at this location was analyzed for benzene using the SPLP method; benzene was not detected in this sample (Table 27).

AOC 11

- No constituents of interest were identified in the surface soil samples from this area (Table 8).
- Benzene was detected in three soil samples (Table 9) at concentrations above the Act 2 MSC as follows: 11-SB-1 at 1600 $\mu\text{g}/\text{kg}$ (8 to 10 feet bgs), 11-SB-2 at 990 $\mu\text{g}/\text{kg}$ (13 to 15 feet bgs, sample of waste material), and 11-SB-7 at 2,100 $\mu\text{g}/\text{kg}$ (13 to 15 feet bgs, sample of waste material). Two samples were collected from the same depths at each location (soil at 11-SB-1 and waste at 11-SB-7); both samples were analyzed for benzene using the SPLP method. Benzene was not detected in either sample (Table 27).
- N-Propylbenzene was detected above the Act 2 MSC at a concentration of 4900 $\mu\text{g}/\text{kg}$ in a sample of waste material collected from 11-SB-7 at a depth of 13 to 15 feet bgs (Table 9). The SPLP data for a soil sample collected from the same depth at this location showed that n-propylbenzene was not detected (Table 27).

AOC 13

- No constituents of interest were detected in the surface soil samples collected from this area (Table 12).
- Carbon tetrachloride was detected at a concentration of 2,800 $\mu\text{g}/\text{kg}$, above the Act 2 MSC, in a sample of waste material from 13-SB-1 (19 to 20 feet

bgs, Table 13). In a sample collected from the same depth at this location, carbon tetrachloride was not detected following SPLP analysis (Table 27).

AOC 14

- No constituents of interest were detected in the surface soil samples collected from this area (Table 14).
- Carbon tetrachloride was detected in a sample of waste material from 14-SB-2 (10 to 12 feet bgs) at a concentration of 1,900 $\mu\text{g/kg}$, above the Act 2 MSC (Table 15). The waste materials placed in AOC 14 are the same as those placed in AOC 13; therefore, the SPLP results for carbon tetrachloride (not detected) from sample 13-SB-2 (Table 27), as described previously, would be representative of this area as well.

AOC 15/Area 5

- Benzene was detected in a surface soil sample (0 to 2 feet bgs) from 15-SB-1 at a concentration of 2,100 $\mu\text{g/kg}$, which is above the Act 2 MSC (Table 16). A corresponding soil sample was analyzed for benzene using the SPLP method; benzene was not detected in this sample above the laboratory-reported detection limit (an estimated concentration of 0.18 micrograms per liter, or $\mu\text{g/l}$, was reported; Table 27). Benzene also was detected above the Act 2 MSC at a concentration of 990 $\mu\text{g/kg}$ (above the Act 2 MSC) at 15-SB-2 (2 to 4 feet bgs; Table 17); benzene was not detected in a sample from the same depth at this location that was analyzed using the SPLP method (Table 27).
- Tetrachloroethene (PCE) was detected in two soil samples (Tables 16 and 17), above the Act 2 MSC, as follows: 15-SB-9 at 950 $\mu\text{g/kg}$ (0 to 2 feet bgs) and 15-SB-2 at 1,200 $\mu\text{g/kg}$ (2 to 4 feet bgs). In a sample collected from 2 to 4 feet bgs at 15-SB-2 that was analyzed using the SPLP method, PCE was not detected (Table 27).
- Lead was detected above the Act 2 MSC at a concentration of 790 milligrams per kilogram (mg/kg) in a soil sample from 15-SB-6 at a depth of 2 to 4 feet

bgs (Table 17). The SPLP result for lead from a corresponding soil sample (Table 27) also exceeded the Act 2 MSC (for groundwater in a used aquifer); however, the concentration of total lead in the soil sample from 6 to 8 feet bgs at this location was below the Act 2 MSC (Table 17). In accordance with the Statewide Health standards, a buffer zone of 10 feet can be applied to this sample indicating that the lead concentration identified at 2 to 4 feet would not be considered to exceed the Statewide Health standard. The application of the 10-foot buffer zone is based on observations made during the advancement of boring 15-SB6 (November 2000), which was extended to 20 feet bgs. Groundwater was not encountered throughout the total depth of this boring.

AOC 16

- No constituents of interest were identified in the surface soil samples collected from this area (Table 18).
- Nickel was detected above the Act 2 MSC at a concentration of 800 mg/kg in 16-SB-4 at a depth of 6 to 8 feet bgs. A soil sample was collected from the same depth at this location and analyzed for metals using the SPLP method; nickel was not detected in this sample (Table 27).

Area 15

- Lead was detected in a surface soil sample from this area (A15-SB-6) above the Act 2 MSC at a concentration of 2700 mg/kg (Table 25). A corresponding sample was analyzed for lead using the SPLP method; lead was not detected in this sample (Table 27).
- Mercury was detected in one surface and one subsurface soil sample from this area (A15-SB-6) at concentrations of 31 mg/kg (0 to 2 feet bgs; Table 25) and 18 mg/kg (2 to 4 feet bgs; Table 26)). A surface soil sample from A15-SB-6 was analyzed for mercury using the SPLP method; mercury was not detected in this sample (Table 27).

As described in the previous sections, very few constituents of interest were detected in the soil above the Act 2 MSCs. In most cases, where the MSCs were exceeded, the constituents were not detected in the sample results reported for SPLP analyses of corresponding soil samples. The only exception to this is for lead in AOC 15; however, as described previously, a buffer zone of 10 feet can be applied and the Statewide Health standard will not be exceeded.

The data collected as a result of the SPLP analyses generally show that the constituents detected in the various AOCs and former operational areas tend to be bound to the soil or waste matrices. The constituent concentrations detected in the SPLP extracts were well below the relevant Act 2 standards used for comparison, with the exception of the sample for lead from AOC 15 (where the buffer zone is known to apply). This indicates that the constituents are not mobile within the environment, which is further reflected in the results of the groundwater investigation.

Basically, disposal areas are not releasing haz?

3.2 Groundwater

Limited groundwater sampling has been conducted in conjunction with the RI activities at the facility. Section 6 contains a proposed groundwater investigative plan, developed to generate additional groundwater data from nine Management Areas (MAs) at the facility. The groundwater sampling conducted to date has focused on the confirmation of previous groundwater results for monitoring wells already installed at the facility. The groundwater data from these sampling events are presented in Table 30; the monitoring well locations are shown on Figure 16. Groundwater data collected during the preliminary RI activities (ESC, 1999) are presented in Table 31; the monitoring well locations are shown on Figure 2. These data were compared to the Act 2 Statewide Health MSCs for groundwater in a used aquifer. ✓

Benzene and lead are the only constituents that were identified in groundwater at concentrations above the corresponding MSCs. The benzene concentrations in monitoring wells 903 (measured in November 2000) and 904 (measured in December 1998 and November 2000) appear to be associated with the historical operation of AOC 3 (former Lagoon Number 4, used to store oily waxes). Similarly, the concentration of lead in monitoring well 904 (measured in December 1998) also appears to be associated with

the historical operation of AOC 3. Concentrations of lead that exceed the MSC in the remaining wells measured in December 1998, may be naturally occurring, based on comparison of the lead concentrations (ranging from 0.007 to 0.009) to the concentration of lead in upgradient monitoring well OW-1 (0.009 mg/l).

Potable water is available to the facility (currently, bottled water is used at the facility for drinking water) and the surrounding community by a municipal water system managed by the Petrolia Water Authority. The source of supply for the water authority is comprised of three groundwater wells and a small spring, all of which are located north of the facility (Figure 17). A representative of the water authority stated in a telephone conversation with ESC, that the authority services the Borough of Petrolia, as well as approximately 30 residences within the surrounding township. The authority contact was aware of only one residence in the vicinity that was not using public water. This residence is located approximately 0.2 miles north of the facility on Forest Street within the Borough of Petrolia.

ESC evaluated the potential for other groundwater users to be present in the area through a search of the PADEP groundwater well inventory. The results of the search are provided on Figure 17. Figure 17 was constructed using data from the Pennsylvania Groundwater Well Inventory System which includes construction, location, improvement, and hydrogeologic data for Pennsylvania water wells. The data is gathered from databases of the Pennsylvania Topographic and Geologic survey, the U.S. Geological Survey, the PADEP, and the Pennsylvania Department of Agriculture, and is current through 1998. The database was queried for wells located within a two-mile radius of the facility. The wells identified in the search results were plotted on a topographic base map to create Figure 17.

3.3 Surface Water

Groundwater from the site may discharge to the surface water of the South Branch of Bear Creek. The potential constituent of interest is benzene that was identified in groundwater associated with AOC 3 (Section 3.2). AOC 3 is located immediately adjacent to the South Branch of Bear Creek. To evaluate the potential for benzene to be detected in the surface water in the creek from a diffuse groundwater discharge, the Act 2

Technical Guidance Manual (PADEP, 1997) provides a mass balance model based on an equation that assumes the total contaminant mass load into the stream is constant and the diffuse flow into the cross-sectional area of the stream is uniformly mixed:

$$C_{sw} = Q_{gw} \times C_{gw} / Q_{sw}$$

where:

Q_{gw} = groundwater discharge from cross-sectional area of plume into stream (L^3/T)

This may be estimated as kiA , where :

k = hydraulic conductivity (L/T)

i = hydraulic gradient at design flow conditions

A = cross-sectional area of plume at point of stream intersection (L^2)

C_{gw} = area weighted average concentration of contamination in plume (mass/volume, e.g., $\mu g/l$)

Q_{sw} = surface water quantity upstream of the site at design flow conditions (L^3/T) using harmonic mean flow for carcinogens and Q_{7-10} (7day/10year low flow) for noncarcinogens

C_{sw} = surface water concentration (mass/volume)

The value obtained for C_{sw} is then compared to the applicable PADEP surface water quality standard from Chapter 16 of Title 25. ✓

To obtain $Q_{gw} \times C_{gw}$ in the above equation, a fate and transport model was used, *SWLOAD* (SWL), that is a spreadsheet application model obtained from the PADEP's Act 2 web site (PADEP, 2001). Appendix C provides the supporting documentation for the SWL and mass balance model.

The results of the SWL and the mass balance model indicate that the in-stream concentration of benzene, at the design harmonic mean flow, is $0.85 \mu g/l$. This is less than the human health criteria of $1 \mu g/l$ based on a cancer risk level of 1×10^{-6} , and less than the fish and aquatic life criteria of $128 \mu g/l$ based on chronic exposure. Surface

water samples were collected upstream and downstream of AOC 3 in November 2000. The data are presented in Table 32 and the sample locations are shown on Figure 16. The surface water quality data supports the results of the modeling as there were no detections of benzene in the South Branch of Bear Creek.

SURFACE WATER OK!

4.0 Potential Receptors and Pathways of Exposure

Exposure assessment is an analysis that qualitatively evaluates the general exposure scenarios that would apply to the facility. The objective of the exposure assessment was to estimate the type and magnitude of potential human and ecological exposure to the constituents identified in the various media. For exposure to occur, the following components of the exposure pathway must exist:

- a source and mechanism of constituent release to the environment
- an environmental transport medium
- a point of potential exposure to identified constituents
- an exposure route at the exposure point

The pathway analysis completed for this facility is summarized in the CSM presented in Figure 18 for potential human and ecological receptors, based on the known land use of the facility and surrounding area. The figure notes which pathways are considered to be potentially complete, incomplete, or insignificant based on the four components identified above. In this CSM, the foreseeable land use is based on the continued industrial operation of the facility, the presence of two adjacent similar industrial facilities and the rural characteristics of the general area in which the facility is located.

The following are the current and future land use assumptions that were used in the development of the CSM:

- The facility is operated by Crompton 24 hours per day, seven days per week.
- The property has been in continuous use for industrial purposes since 1885.
- The facility is bordered to the north and south by large industrial properties (Indspec to the north and Penreco to the south), and to the southwest and west by strip mines and undeveloped property. A small residential area is located along the northwest property boundary. Predominantly undeveloped property is located to the east.
- Access to facility operational areas is restricted by perimeter fencing; site access is also restricted by 24-hour security. An extensive facility health and

safety program, including a training requirement before admittance to the operational areas, also serves to restrict site access to facility employees and authorized visitors.

- ✓ • The current land use is not anticipated to change in the near future and Crompton has no plans to discontinue operations at the facility.
- ✓ • Crompton uses bottled water for potable purposes at the facility. Non-contact cooling water and water for the fire-protection reservoir is obtained from two production wells on the facility property. Water for sanitary purposes and process water is obtained from two wells located approximately two miles east of the facility; these wells are owned and operated by Crompton (U.S. Army Corps of Engineers, 1999).
- ✓ • Public drinking water is available to residents of Petrolia and the immediate vicinity. No domestic groundwater wells were identified immediately adjacent to the active areas of the facility based on a search of the Pennsylvania well inventory database and information provided by a representative of the Petrolia Water Authority.

The current and future potential human and ecological receptors for the facility and nearby areas include:

- ✓ • Onsite workers – employees of Crompton during both routine operation of the facility and during construction or maintenance activities.
- ✓ • Trespassers – individuals who illegally gain access to the operational areas Crompton's property.
- ✓ • Offsite residents – residents located downgradient of the facility.
- Regional and local biota – terrestrial and aquatic receptors that thrive or forage onsite or inhabit Bear Creek.

A discussion of the potential exposure scenarios that were evaluated for this facility, based on the data obtained to date, is presented in the following sections.

4.1 Soil surface soil -- *post closure requirements*

As described in Section 3.1, no constituents of interest were identified in the soil samples collected at the facility as part of the RI activities. As a result, there are no complete pathways of exposure for soil and consideration of potential human receptors is unnecessary.

4.2 Groundwater

Groundwater containing benzene at concentrations above relevant screening criteria was identified at the facility. The following are the potential groundwater pathways of exposure considered for the facility:

- Direct contact with groundwater used as a potable resource by human receptors including ingestion and dermal contact - bottled water is used by the facility for drinking, and public drinking water is available to the surrounding community. In addition, no groundwater users were identified immediately adjacent to the active areas of the facility. As a result, direct contact with groundwater used as a potable resource is not considered to be a likely pathway of exposure.
- Direct contact with groundwater by human receptors during subsurface excavation - this may be a complete pathway if excavation occurs within the area where benzene was detected in groundwater above the MSC (AOC 3).
- Indirect contact by human receptors including inhalation of volatile emissions - again, because public water is available to the facility and surrounding community, this is not considered to be a likely pathway of exposure.

*Fate
of
"plume"*

This evaluation will be reconsidered after the additional groundwater data is collected.

4.3 Surface Water

No constituents of interest were identified in the surface water samples collected from the facility. In addition, the results of the mass balance calculation showed the benzene concentration in groundwater associated with AOC 3 will not exceed the relevant surface water quality criteria as groundwater discharges to the nearby creek.

Therefore, there are no complete pathways of exposure for this medium. This evaluation will be reconsidered after additional groundwater data is collected.

4.4 Ecology

The potential ecological impacts will be addressed using the ecological screening procedures presented in the Act 2 Technical Guidance Manual (PADEP, 1997) and pursuant to Corrective Action requirements under the RCRA. There are no Act 2 Statewide Health Standard MSCs for evaluation of the soil, surface water, and sediment pathways for ecological receptors. Rather, the appropriate screening procedure used is based on the selected Statewide Health Standard or Site-Specific Standard for human receptors per regulated substance, each medium of concern, or by distinct area of contamination. It is noted that both of these screening procedures reference the applicable EPA ecological risk assessment guidance documents, and, therefore, the selected screening procedures will be in accordance with applicable requirements under the RCRA.

As of the date of this CSM, there is not enough information to determine whether these potential ecological risks will be addressed using the Act 2 Statewide Health Standard or Site-Specific Standard. As presented in the introduction to this CSM, the purpose of the CSM is to summarize Crompton's current understanding of the site based on data collected to date and to define the site management strategy for moving forward. Once the RI activities for the facility have been completed, the path forward for addressing potential ecological risks will be implemented.

5.0 Conceptual Site Model Summary

Investigation of the Crompton Petrolia facility is being conducted in accordance with the RI work plan (ESC, 2000). To date, the soil characterization activities have been completed, and the data show that the constituents identified in the soil within the AOCs do not exceed the Act 2 Statewide Health Standard MSCs for Nonresidential Use. As a result, no further evaluation of the soil will be necessary to meet the objectives of the RI, which include the following for soil: *gw protection*

- verify the presence or absence of constituents of interest released to soil within AOCs at the facility
- provide sufficient data to develop a CSM of the facility to identify potential contaminant migration pathways and to apply appropriate remediation standards specific to each AOC within the facility
- provide data to assist with an evaluation of applicable remediation technologies and alternatives consistent with Act 2 and RCRA corrective action requirements

For groundwater at the facility, the data collected to date form the basis of the proposed groundwater investigation strategy that will meet the objectives of the RI including (in addition to those already described for soil, as applicable):

- characterize the potential effects of historical waste management and plant operations on the facility groundwater quality
- characterize the potential effects of regional groundwater impacts on facility groundwater
- *determine the fate of released material*

With respect to the potential for migration of constituents in general to the groundwater from the AOCs, the following should be noted:

- the SPLP data collected from the AOCs reflect a very low probability that the constituents present within the soil or waste have migrated to the groundwater in the past, or will become mobile at some point in the future

- the raw materials used by the facility and the resultant products generally tend to be of low toxicity
- evaluation of the groundwater data collected to date suggests that the presence of constituents (benzene and lead) detected above the Act 2 MSCs represents a localized effect, resulting from the historical operations of AOC 3; based on a review of the remaining data, there is no evidence to indicate site-wide groundwater contamination

CAPPING & permanent monitoring

Through modeling and sampling, the surface water at the facility (South Branch of Bear Creek) has been demonstrated to contain no constituents of interest. As a result, no further evaluation of the surface water is proposed.

6.0 Proposed Groundwater Investigation Plan

In order to formulate a reasonable groundwater investigation strategy to satisfy all federal and state requirements for the site, the facility AOCs were grouped into MAs based on geographic location, taking into account local hydrogeology and the regulated substances present within each area. The following MAs, and the AOCs that comprise each MA, are shown on Figure 19:

- MA 1 – AOC 9, AOC 11, and AOC 12
- MA 2 – AOC 18, AOC 18A, AOC 13, and AOC 14
- MA 3 – Area 15
- MA 4 – Area 5 and AOC 15
- MA 5 – AOC 16
- MA 6 – AOC 8 (and AOC 3, see discussion below)
- MA 7 – AOC 17 and AOC 17A

Some of the AOCs previously closed with PADEP approval have been included in the identification of MAs at the site since Act 2 liability protection for groundwater in these areas will be sought. Accordingly, MA 8 (AOC 1 and AOC 2) and MA 9 (AOC 4, AOC 5, AOC 6, and AOC 7) have been included and MA 6 has been expanded to include AOC 3.

AOC 10 has not been included within the MAs and no groundwater monitoring will be proposed for this area. As stated previously, AOC 10 was used as a spray irrigation field for supernatant wastewater from lime and alum neutralization of raw wastewater. In the late 1960s, wastewater was sprayed at the top of the hill and was allowed to biodegrade as it moved down the hillside. Soil sampling conducted during RI activities (see Section 3.0) showed that no constituents of interest were detected in this area. Therefore, no additional investigation of this area is proposed.

6.1 Management Area Geology

A discussion of the geology for MA 1 through MA 7 is presented in the following sections, based on the information obtained during RI characterization and delineation

activities (Section 3.0). The cross section locations for each of these MAs are shown on Figure 20. Cross section descriptions for MA 8 and MA 9 are not presented in this CSM because the AOCs incorporated into these areas were closed before the current RI activities were conducted.

Management Area 1 (AOCs 9, 11 and 12)

Cross section 9A-9A' (Figure 21) transverses the center of AOC 9, which is located in the eastern portion of MA 1, from a northwest to southeast direction. During subsurface investigations, native fill (sand, silt, and clay), and coke fines were encountered. In AOC 9, an approximately 20-foot thick coke fine layer is capped by the native fill and is underlain by clay.

Cross section 9/12-9/12' (Figure 21) transverses the southern portions of AOCs 9 and 12 (southern portion of MA 1) from southwest to northeast. Black silty waste, approximately 15 feet thick, grades into coke fines near the southern boundary of AOC 9. The waste material and coke fines are capped with native fill (sand, silt, and clay) and are underlain by silty clay. Bedrock, as determined from boring W-2, consists of a sequence of claystone, sandstone, and shale.

Cross section 11/12A-11/12A' (Figure 21) transverses the center of AOC 11 (northwestern portion of MA 1) from northwest to southeast and the western edge of AOC 12 from north to south. Black silty waste and coke fines are capped with a native fill (sand, silt, and clay) layer of variable thickness. Native soil was encountered at depth in borings 11-SB1 and 11-SB3. Generally, black silty waste was found in AOC 11 and in the southern portion of AOC 12. Coke fines were encountered in boring 11-SB3. ESC was unable to determine the full depth of the waste material due to the drilling capability of the Geoprobe® unit.

Management Area 2 (AOCs 13, 14 and 18A)

Cross section 18A-18A' (Figure 22) transverses AOC 18, which is located in the southeastern portion of MA 2, from northwest to southeast. The topography in this area of the facility slopes steeply towards the southeast. Fill, coke fines, black silty waste, native soil, shale, and sandstone were encountered during the subsurface investigation.

Coke fines and waste material were found in the western portion of AOC 18 and thinned from approximately 5 feet at test pit 18-TP5 to 1 foot at boring 18-SB15. A 4-foot thick layer of coke fines and waste was encountered down slope at approximately 2 feet bgs. The waste material was capped by fill and underlain by clay or shale. Bedrock encountered during the installation of monitoring well MW-1 consisted of sandstone and shale.

Cross section 13/14A-13/14A' (Figure 22) transverses AOCs 13 and 14, which are in the northwestern portion of MA 2, from north to south. Black silty waste was encountered in all borings with the exception of 13-SB3. The waste ranged in thickness from approximately 40 feet to 12 feet. The waste is capped with a gravel, sand, silt and clay fill material and underlain by sandstone at boring 14-SB1 and clay/silty clay at borings 14-SB2 and 13-SB2. Saturated conditions were encountered at approximately 18 feet below ground surface in boring 13-SB2.

Management Areas 3 and 5 (Operational Area 15)

Cross section A15A-A15A' (Figure 23) transverses MA 3 from northwest to southeast. Clayey waste material, approximately 3 feet thick, capped by fill was encountered between borings A15-SB4 and A15-SB6. Native soil and weathered sandstone were found in borings A15-SB2, A15-SB8, and A15-SB9.

Cross section 16A-16A' traverses MA 5 from north to south. Fill material, consisting predominantly of silt and clay, with minor amounts of sand and gravel, was encountered between borings 16-SB7 and 16-SB1. Sandy gravel was encountered in 16-SB8.

Cross section A15/16A-A15/16A' (Figure 23) transverses MAs 3 and 5 from east to west. The topography changes rapidly from boring A15-SB8 (approximately 1,250 feet MSL) to 16-SB3 (approximately 1180 feet MSL) and rises to approximately 1,205 feet MSL at well MW-I3. Native soil (silt and clay), sandstone, coal, and shale were encountered in the borings within this area. Fill consisting of silt, sand, gravel, and brick was encountered in MA 5. Saturated conditions were encountered at borings 16-SB3 at approximately 8 feet bgs.

Management Areas 4 and 6 (AOC 8 and 15)

Cross-section 8/15A-8/15A' (Figure 24) transverses MAs 4 and 6 from north to south. A discontinuous layer of variable thickness consisting of black silty waste was encountered in four borings. The waste material is capped with fill consisting of rock, brick and silt and is underlain by native soils consisting of clay, silt and sand. Shale and sandstone were encountered at approximately 20 and 25 feet bgs, respectively.

Management Area 7 (AOCs 17 and 17A)

Cross-section 17A-17A' (Figure 25) transverses MA 7 from northwest to southeast. A black silty waste layer capped with fill was encountered in both AOCs. Shale was encountered at depth in all of the borings with the exception of 17-SB3.

Cross section 17B-17B' (Figure 25) transverses AOC 17A from southwest to northeast. Black silty waste capped with fill and underlain by shale and sandstone, was encountered in borings 17A-TP3, 17A-SB4 and 17A-SB7. Native soils and bedrock were encountered in well MW-6 and 17A-SB9.

Cross section 17C-17C' (Figure 25) transverses the central portion of AOC 17. The topography changes rapidly between borings 17-SB3 and MW-10 (approximately 50 feet). A black silty waste layer, of variable thickness, was encountered in borings 17-SB3 and 17-TP6, underlain by silt and shale. Native soils (sand, silt and clay) and shale, sandstone, and coal were encountered in the other borings.

6.2 Proposed Investigation Strategy

The groundwater quality at the facility will be investigated by establishing groundwater monitoring systems around the MAs described above, and as shown on Figure 19. The monitoring systems will consist of new and existing monitoring wells as summarized in Table 33. The MAs were established based on geographic location, local hydrogeology, and the constituents of interest present within each AOC. The AOCs that comprise each MA are listed on Figure 19. The monitoring well locations around each MA were selected to facilitate the collection of groundwater samples representative of upgradient and downgradient water quality within the uppermost aquifer in each area. Monitoring systems located in upland portions of the site will most likely be completed in

a water-bearing zone present within the Butler and Worthington sandstones. Monitoring wells located in low-lying areas will be completed in shallow unconsolidated deposits.

Following installation and development of newly completed wells, one round of groundwater samples will be collected from the new and existing wells within each MA. Groundwater samples will be analyzed for VOCs using SW-846 Method 8260, SVOCs using SW-846 Method 8270, and Act 2 dissolved metals using SW-846 6010/7000. Groundwater elevation measurements will also be collected to verify the direction of groundwater flow and the design of each monitoring well system. Groundwater monitoring well installation and sampling procedures will be conducted in accordance with the procedures provided in the Remedial Investigation Work Plan prepared by ESC and dated March 31, 2000.

Groundwater investigations will be discontinued at a given MA if sampling results reveal no constituents of interest at concentrations above Act 2 Statewide Health Standard, non-residential, MSCs. However, if Statewide Health Standards are exceeded, the need for additional site characterization activities will be evaluated at a given MA based on a risk-based process to determine the nature and extent of affected groundwater.

from 1 round
of sampling?
with waste material
left in place?
post-closure?
with this
explain how ~~coal~~
fits into this.

7.0 References

- Dodge, C.H. 1985. Coal Resources of Butler County, Pennsylvania. Part 1 Coal Crop Lines, Mined-Out Areas, and Structure Contours. Pennsylvania Topographic and Geologic Survey. Mineral Resources Report 90.
- Chemviron, 1987. Intermediate and Deep Aquifer Investigation to Determine Water Quality. Prepared for Witco Corporation by Chemviron, Inc. September 1987.
- Dodge, Clifford H. 1985. Coal Resources of Butler County, Pennsylvania, Part 1. Coal Crop Lines, Mined-Out Areas, and Structure Contours. Commonwealth of Pennsylvania, Department of Environmental Resources.
- Environmental Strategies Corporation. 2000. Remedial Investigation Work Plan for CK Witco Corporation, Petrolia, Pennsylvania.
- Environmental Strategies Corporation. 1999. Preliminary Remedial Investigation for Witco Corporation, Petrolia, Pennsylvania. Revision No. 1.
- NUS, 1985. Revised Closure Plan of Existing Landfill. Prepared for Witco Chemical Corporation by NUS Corporation. July 1985.
- Pennsylvania Department of Environmental Protection. 1998. Ecological Screening Procedures for Sites in Pennsylvania. Act 2 Technical Guidance Manual. Attachment V.E.3., Revision 0, November 1998.
- Pennsylvania Department of Environmental Protection. 1997. Technical Guidance Manual. Pennsylvania Land Recycling and Remediation Standards Act (Act2) Final Draft.
http://www.dep.state.pa.us/dep/deputate/airwaste/wm/landrecy/Vol_Clnup.htm
- United States Army Corps of Engineers. 1999. Environmental Indicator Inspection Report for Witco Chemical Corporation, Petrolia, Pennsylvania, EPA ID# PAD 004 388 500.
- United States Fish and Wildlife Service. 1973. Warren SW Oil City National Wetlands Inventory Map (Parker USGS Quadrangle). Washington, D.C.
<http://www.nwi.fws.gov/>